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Neighborhood Factors Affecting Rates of Sexually Transmitted Diseases in Chicago

James C. Thomas, Elizabeth A. Torrone, and Christopher R. Browning

ABSTRACT *High rates of gonorrhea have been shown to be associated with high rates of incarceration in the prior year. One hypothesized chain of events is that there is a negative effect of incarceration on neighborhood social characteristics, which in turn affect behaviors facilitating transmission of sexually transmitted diseases (STDs). This study examined whether neighborhood characteristics were associated with the incidence of STDs and homicide rates as a proxy for incarceration rates. Data were from the 1995 Program on Human Development in Chicago Neighborhoods, the Chicago Health Department, and the Chicago Police Department. Neighborhood gonorrhea rates increased by 192.2 (95% confidence interval (CI) 131.6, 252.9) cases per 100,000 population with a change from the 25th to the 75th percentile of social disorder. This rate difference was a value greater than the median neighborhood gonorrhea rate. Similar increases were observed for other neighborhood measures and for Chlamydia infection. We hypothesize that high rates of incarceration may play a role in undermining neighborhood social cohesion and control. Using homicide rates as a proxy for incarceration, a change from the 25th to the 75th percentile of 1995 neighborhood homicide rates yielded a gonorrhea rate increase of 164.6 (95% CI 124.4, 204.7) cases per 100,000. Factors that undermine the social fabric of a community can become manifest in health outcomes such as STDs. The effects of high rates of incarceration on neighborhoods merit further exploration.*

KEYWORDS *Neighborhoods, Social disorder, Sexually transmitted diseases, Incarceration*

Sex is usually regarded as an act based on the decisions of an individual or pair. A community or society's efforts to reduce sex and its negative consequences, such as sexually transmitted diseases (STDs) and unwanted pregnancy, are often directed at individuals. An example is the "ABC" approach to HIV/AIDS prevention where A is for abstinence, B is for "be faithful" to your sexual partner, and C is for condoms. The motivations for sex, however, are many and complex. They include desires for intimacy, a mate, a child, power, material goods, pleasure, drugs to satisfy a habit, and more.

Thomas et al. chronicled how social forces such as post-Depression Era agricultural policies, Jim Crow laws, the Great Migration from the rural south to the urban north, and the crack epidemic-enabled high rates of STDs in rural North Carolina.[1] The principal governmental response to the crack epidemic was the War on Drugs which incurred stricter sentencing laws for drug-related crimes. During the 1980s and 1990s, rates of imprisonment in the US increased more than tenfold.

Thomas and Torrone are with the University of North Carolina, Chapel Hill, NC, USA; Browning is with the Ohio State University, Columbus, OH, USA.

Correspondence: James C. Thomas, University of North Carolina, Chapel Hill, NC, USA. (E-mail: jim.thomas@unc.edu)

High rates of incarceration can lead to unintended consequences. Clear et al. found that incarceration rates reached a point of diminishing returns in reducing future crime in Tallahasee, Florida.[2] At the highest level, more incarceration even increased crime. They hypothesized that high rates of incarceration undermined social ties by removing large numbers of people from the community.

Thomas and colleagues have suggested further that people who lose a loved one to prison are also affected in ways that can negatively influence social cohesion and control in the family and community and lead to sexual behaviors that can result in STDs and teen pregnancy.[3,4] They reported correlations between rates of incarceration and sex-related outcomes (STDs and teen pregnancy) in the 100 counties of North Carolina and between incarceration rates and STDs in the census tracts of two of the counties.[4–6] Researchers have also found relationships between STD rates and male/female ratios at county and census tract levels,[7,8] the presence of an interstate highway at the county level,[9] and measures of economic deprivation at the census tract and block group levels.[10]

We hypothesize that high rates of incarceration affect neighborhood characteristics, resulting in sex-related health outcomes such as STDs and teen pregnancy. As large numbers of people are removed from a neighborhood, the people left behind experience deterioration in social cohesion, social control, and other measures. We believe these social factors are some of the means by which communities influence sexual relationships among their residents.

In a study of ten-block groups in Baltimore, social cohesion (neighbors getting along and trusting each other) was found to be lower in the five-block groups with higher rates of gonorrhea.[11] However, the results of this study cannot be generalized to all of Baltimore. It was conducted only in the ten-block groups with the most poverty and the least residential stability. The data for measuring social cohesion were obtained from street-intercept interviews with 18 to 24-year-old individuals rather than a full range of adults living in the neighborhood. Furthermore, the study did not yield an estimate of the strength of the association or the public health impact.

METHODS

The best data available on neighborhood characteristics were collected by researchers from Harvard and the University of Chicago in the mid 1990s as part of the Program on Human Development in Chicago Neighborhoods (PHDCN).[12] The study covered 343 contiguous neighborhoods in the entire city of Chicago and included several neighborhood measures beyond social cohesion, such as social control, social disorder, and social capital. Data on perceived violence were also part of the PHDCN study. To these data we added neighborhood homicide and STD rates to study the relationships between crime, neighborhood characteristics, and STDs.

Of 64 cities with populations greater than 200,000 for which CDC reported STD numbers and rates in 1996, Chicago ranked second for the number of reported gonorrhea infections (11,383) and 19th for the rate (386.1 cases per 100,000 population). The city ranked third for the number of reported Chlamydia infections (12,356) and 17th for the rate (419.1 cases per 100,000 population).[13]

To estimate the strength of the association between crime, neighborhood characteristics, and STD rates in Chicago, we obtained and linked multiple data sources, including a public health communicable disease database, census, and crime

data sources and data from the PHDCN study. This ecological analysis was conducted at the neighborhood level, with neighborhoods defined as clusters of census tracts with similar population characteristics ($n=343$).[12]

Neighborhood Factors

The PHDCN community survey was conducted in 1995. Using a multistage sampling framework, 8,782 residents in 343 neighborhoods were interviewed about their perceptions of their neighborhood and social ties with their neighbors. From the survey, the PHDCN investigators constructed indices with known properties to measure social capital (in this case, parents watching over the children of the neighborhood), social cohesion (neighbors getting along and trusting each other), social control (neighbors will intercede when there is negative social behavior), social disorder (public drinking, drug dealing, loitering in groups), and perceived violence. In addition, a measure of collective efficacy, the ability of community to work together to enact change,[12] was derived from a combination of social cohesion and control. A description of the survey questions comprising each measure can be found elsewhere,[12] but as an example, social cohesion was measured by survey questions using a Likert-type scale ("Would you say you strongly agree, agree, neither agree/disagree, disagree or strongly disagree with the following statements" [paraphrased here]): (1) This is a close-knit neighborhood. (2) People are willing to help their neighbors. (3) People do not get along. (4) People in the neighborhood do not share the same values. (5) People in the neighborhood can be trusted.

The PHDCN sampling strategy yielded within-neighborhood samples of varying sizes (an average of 25 respondents per neighborhood). Variation in the sample size across neighborhoods resulted in neighborhood level scale scores with different levels of reliability. To address this issue, the authors used empirical Bayes residuals from multilevel models of the community survey scales. Empirical Bayes estimates pull neighborhood level mean scale scores toward the overall sample grand mean by a factor proportional to the unreliability with which the scale score has been estimated.[14]

Sexually Transmitted Disease Rates

The Chicago Department of Public Health provided counts of all reported gonorrhea and Chlamydia infections at the census tract level. Both STDs are reported to the Chicago Department of Public Health under mandatory communicable disease control laws. Yearly counts were provided stratified by age, race/ethnicity, and gender for 1996. Age was grouped as <24, 24–44, >44. Census tract counts were aggregated to the PHDCN neighborhood level for linkage to the PHDCN variables. Denominators for the counts were determined by aggregating population counts from the 1990 census into PHDCN neighborhoods.

Additional Neighborhood Measures

Homicide rates for each census tract in Chicago in 1995 were obtained from the Chicago Police Department and log transformed for investigation of the effect of neighborhood crime. Additional characteristics of neighborhoods were derived from 1990 census variables: (1) residential stability defined as percentage of neighborhood residing in the same house for at least 5 years and percentage of owner-occupied homes; (2) immigrant concentration, defined as percentage of foreign-born residents and percentage of Latinos; and (3) concentrated disadvantage, defined as percentage below the poverty line, on public assistance, unemployed, less than 18,

African American and female-headed households. These last three variables were found to be relevant for neighborhood analyses in a factor analysis conducted by the PHDCN study.[12] We employed the same indices used by PHDCN.

Regression Analysis

Based on the distribution of the outcomes of interest, cases of gonorrhea and Chlamydia infection, the authors determined that a negative binomial regression model was most appropriate. They calculated rate differences (RDs) as the STD rate corresponding to the difference of the 25th percentile of each predictor variable to the 75th percentile and corresponding 95% confidence intervals (CIs). Prior analyses have shown that associations between county-level characteristics and STD rates are strongest with a 1-year lag for the STDs.[3] Thus, the authors regressed the 1995 PHDCN and crime data against 1996 STD rates. Based on a conceptual model and previous research on the PHDCN dataset, they decided a priori to include the three census-derived control variables (data not shown). Because of collinearty among the social measures, the authors assessed the influence of each in a separate model. All regression analyses were conducted in Stata 9 (Stata Corp, TX). This research was approved by the Institutional Review Board at the University of North Carolina at Chapel Hill Public Health-Nursing and the Chicago Department of Public Health.

Spatial Analysis

Using ArcView GIS 9.13 (Environmental Systems Research, CA) the authors mapped neighborhood characteristics and GC rates by neighborhood cluster, categorizing each variable by quartiles of equally sized ranges. As there are no currently available methods to account for spatial clustering in negative binomial models, the authors also conducted parallel analyses using linear regression models. In GeoDa (Spatial Analysis Laboratory, IL) the authors first calculated Moran's I to determine spatial correlation of the outcome. Then they calculated RDs and standard errors for each predictor variable with and without spatial correlation weights.

RESULTS

The gonorrhea rates for the PHDCN-defined neighborhoods in 1996 ranged from zero to 2,055.3 cases per 100,000 population, with a median of 184.4 cases per 100,000. Chlamydia infection rates had a similar range but with a median of 345.5 cases per 100,000 (Table 1). As seen in Figure 1 for gonorrhea, the neighborhoods with higher rates formed two large clusters in the southern and western regions of the city.

The geographical distribution of neighborhood homicide rates in 1995 resembled that of gonorrhea in 1996, but the clusters were not as tight (Figure 2). The geographical distributions of the social neighborhood measures had patterns resembling each other and the inverse of the gonorrhea rates (Figure 3). Our assessment of spatial clustering via linear regression techniques revealed negligible spatial correlation among the error residuals (data not shown).

Homicide and perceived neighborhood violence were both positively associated with gonorrhea and Chlamydia infection rates. A change in the homicide rate from the 25th to the 75th percentile yielded a rate difference of 164.6 (95% CI 124.4, 204.7) cases per 100,000 population for gonorrhea and 161.7 (95% CI 124.7,

TABLE 1 Chicago neighborhood characteristics, 1990–1996

	Median	Minimum	Maximum
Sexually transmitted diseases[a]			
Gonorrhea rates per 100,000	184.4	0	2,055.3
Chlamydia rates per 100,000	345.5	0	2,424.2
Crime statistics[b]			
Homicide rate per 100,000	55.0	0	462.6
PHDCN community survey[c]			
Perceived violence	2.0	1.4	3.0
Social disorder	2.0	1.2	2.8
Social capital	3.5	3.0	4.2
Social cohesion	3.3	2.7	4.1
Social control	3.9	3.7	4.1
Collective efficacy	3.9	3.4	4.5
Concentrated disadvantage[d]			
% Below poverty line	15.4	0.2	88.2
% On public assistance	12.1	1.0	77.3
% Females headed families	27.0	6.9	94.7
% Unemployed	11.2	1.9	59.1
% Less than 18	27.2	3.9	56.4
% Black	18.3	0	99.8
Immigrant concentration[d]			
% Latino	6.6	0	96.3
% Foreign born	14.1	0	64.6
Residential stability[d]			
% Same house since 1985	57.6	26.7	81.6
% Owner occupied house	37.9	0	93.5

[a]Provided by the Chicago Department of Public Health, 1996
[b]From Chicago Police Department, 1995
[c]From Program on Human Development in Chicago Neighborhoods survey of 8,782 community residents, 1995
[d]From 1990 census

198.6) cases per 100,000 for Chlamydia infection. The rate difference for gonorrhea was nearly as large as the median neighborhood rate (Table 2).

Each of the five social measures was associated with the gonorrhea and Chlamydia infection rates. Where social capital, social cohesion, social control, and collective efficacy were lower, and where social disorder was higher, gonorrhea and Chlamydia infection rates were higher (Table 2). A change from the 25th to the 75th percentile of social disorder yielded an increase in the gonorrhea rate of 192.2 (95% CI 131.6, 252.9) cases per 100,000, a value that is greater than the median neighborhood gonorrhea rate.

DISCUSSION

In recent eras, STDs were referred to as "social diseases." Although the term "social" in this context was a euphemism for "sexual," there is, indeed, a strong social element to community patterns of STDs. In our study, we found that several measures of social connections were associated with rates of gonorrhea and Chlamydia infection in Chicago neighborhoods.

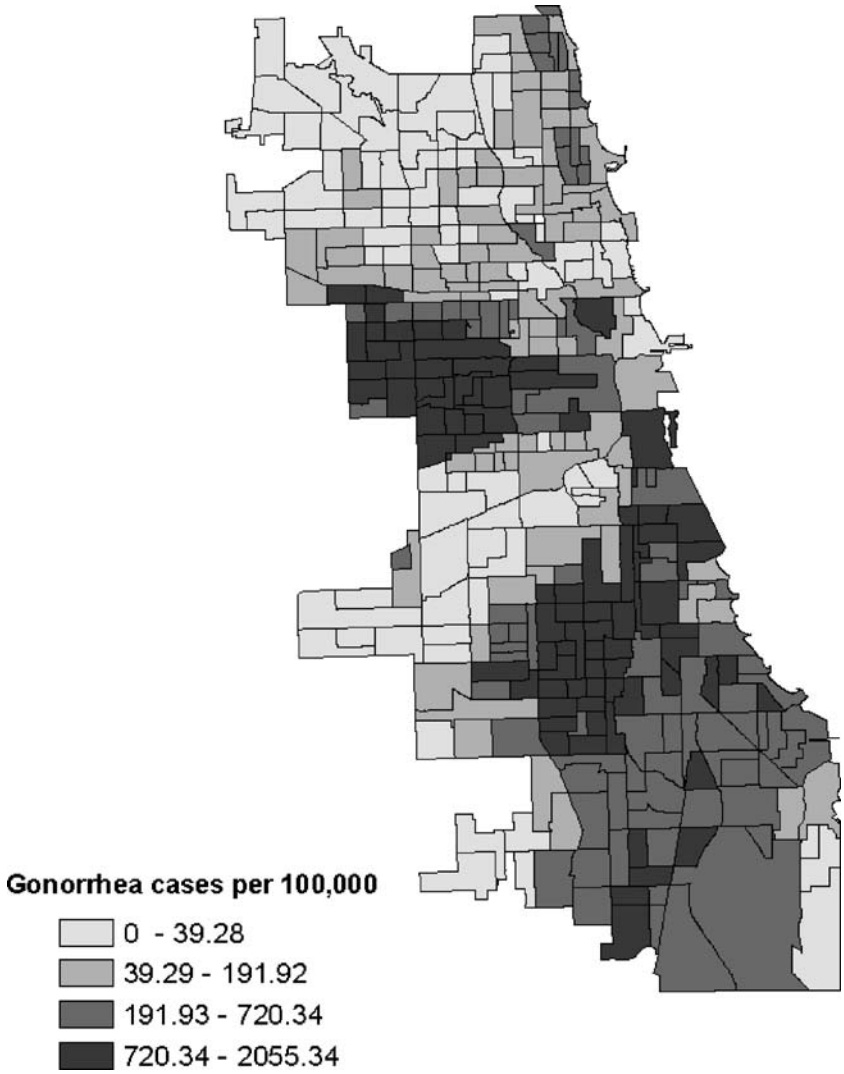

FIGURE 1. 1996 gonorrhea rates in Chicago according to neighborhoods specified by the PHDCN.

Neighborhood Characteristics and STDs

The lack of social cohesion and control that we observed may reflect an absence of some of the usual limits on sexual partnerships. Browning found, for example, that the age of sexual onset was higher in Chicago neighborhoods with greater collective efficacy (a combined measure of cohesion and control), independent of ethnic and racial demographic mix, family processes, peer influences, developmental risk factors, and neighborhood-level-concentrated poverty.[15] STD clinic clients in Baltimore who reported living in a neighborhood with high social cohesion were more likely to use condoms during sex than those in a neighborhood with low social cohesion.[16]

Alternatively or in addition, it may be that each act of sex carries a greater risk of exposure to infection in some neighborhoods. This would be the case where the prevalence of infection is relatively high.[17] The prevalence can become elevated without a commensurate increase in the frequency of sex if the average duration of

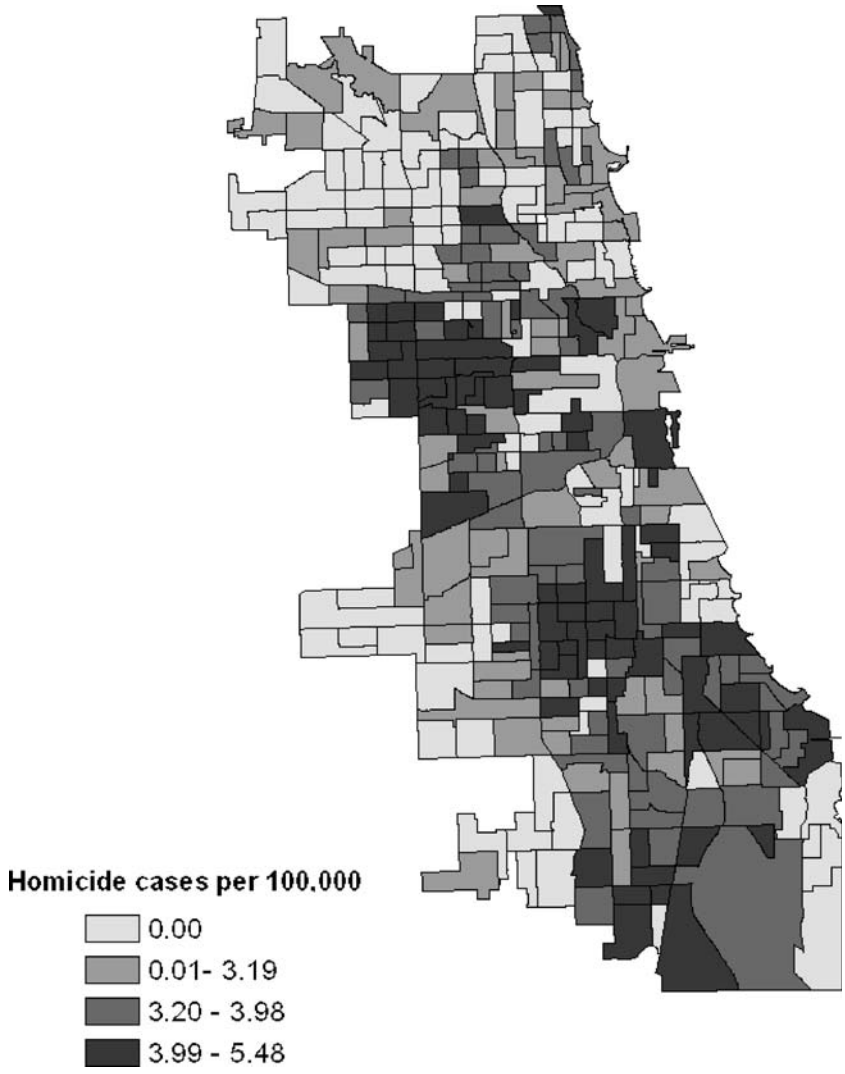

FIGURE 2. 1995 homicide rates in Chicago according to neighborhoods specified by the PHDCN.

infection is relatively long. The duration of a curable infection such as gonorrhea or Chlamydia can be longer in one neighborhood than another if STD treatment services are unavailable, inaccessible, or provided in such a way that people avoid using them.[18] The collective efficacy measure might have captured some aspects of a neighborhood's ability to attract and keep effective STD diagnosis and treatment resources.

Social capital is a construct pertaining to individuals' social investments in their community or society. Measures of social capital vary. One measure relates to participation in civic and social organizations and volunteerism. This form of social capital has also been inversely related to the rates of teen pregnancy, STDs, and AIDS at the state level.[19,20] The PHDCN measure pertained to parents watching over the children of the neighborhood, keeping them out of trouble. Where that trouble stems from idle time or opportunities for sex, a high degree of social capital could result in a delayed onset of first sex, less frequent sex, and fewer STDs.

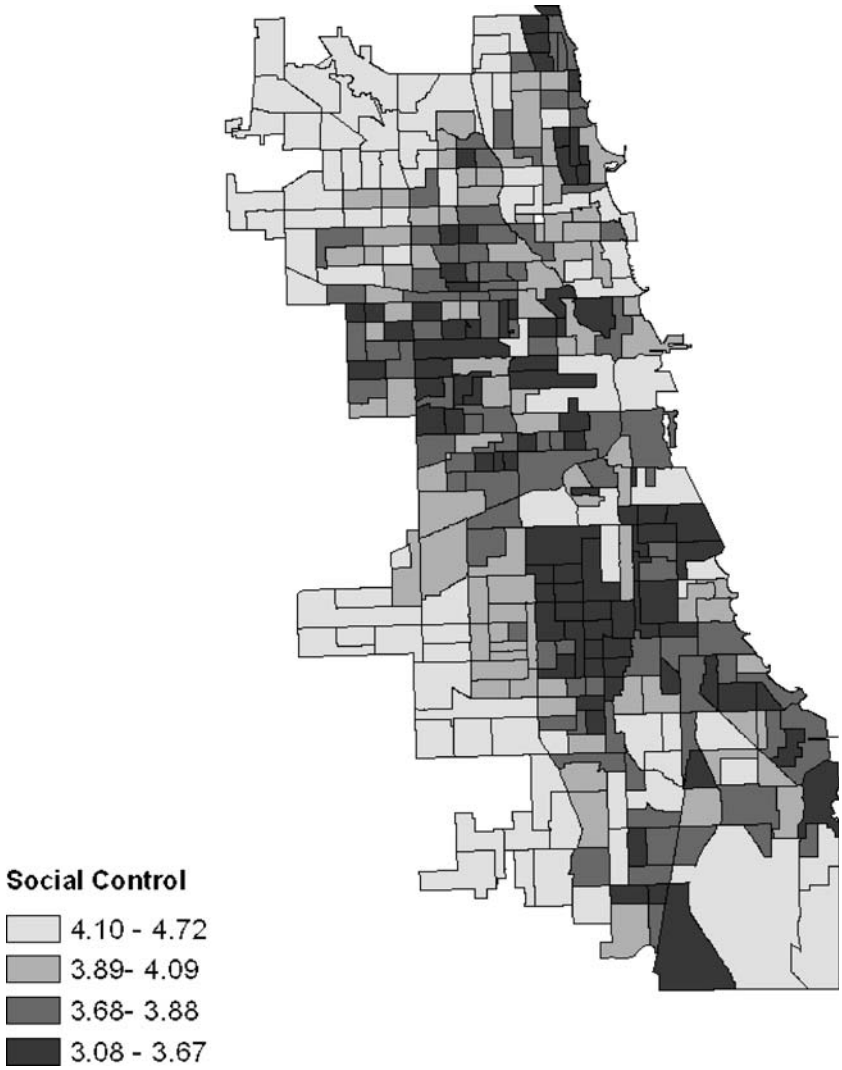

FIGURE 3. 1995 distribution of social control in Chicago according to neighborhoods specified by the PHDCN.

Social disorder, or public displays of antisocial behavior, has two components in the PHDCN study: one animate and one inanimate. Animate social disorder, the measure found to be associated with gonorrhea rates in our study, consists of public drinking, drug dealing, or hanging out and causing trouble. Drinking and sex have long been associated with each other. This measure could also be capturing the exchange of sex for drugs, which has been linked to the transmission of sexually transmitted diseases.[21]

Inanimate or physical social disorder consists of litter and trash in the street, graffiti on buildings and walls, and vacant or deserted houses or storefronts. These neighborhood characteristics are sometimes collectively referred to as "broken windows." Cohen et al. found a direct correlation between an index of broken windows and rates of gonorrhea in New Orleans before hurricane Katrina.[22] Although others have argued for a connection between broken windows and future

TABLE 2 Rate differences (RD) and 95% confidence intervals (CI) assessing the association between neighborhood characteristics (1995) and rates of gonorrhea and Chlamydia infection (1996), Chicago

	Gonorrhea		Chlamydia infection	
	RD	(95% CI)[a]	RD	(95% CI)[a]
Homicides	164.6	124.4, 204.7	161.7	124.7, 198.6
Perceived violence	108.5	57.5, 159.4	109.7	63.1, 156.3
Social disorder	192.2	131.6, 252.9	205.5	154.0, 257.0
Social capital	−67.4	−103.6, −31.2	−85.3	−117.3, −53.3
Social cohesion	−141.1	−194.3, −87.9	−158.4	−204.1, −112.8
Social control	−104.8	−151.3, −58.3	−128.7	−169.4, −88.0
Collective efficacy	−90.8	−133.5, −48.1	−107.9	−145.4, −70.3

[a]Rate difference per 100,000 comparing the 25th percentile of predictor variable to the 75th percentile, adjusted for concentrated disadvantage, residential stability, and immigrant concentration from a negative binomial regression model

crime,[23] Sampson and colleagues demonstrated with PHDCN data that low neighborhood collective efficacy explained both the broken windows and the future crime.[12]

Neighborhood Characteristics and Crime

We attempted to obtain 1994 and 1995 incarceration data for the city of Chicago. However, the Illinois Department of Correction's procedures for updating addresses of prisoners and parolees compromised their utility for geocoding to census tracts reflecting the prisoner's or ex-offender's home. The method has since changed but not in years allowing us to examine a temporal sequence in which incarceration might affect the neighborhood characteristics measured in the PHDCN study.

We hypothesize, however, that homicide rates and levels of neighborhood violence perceived by residents serve as imperfect but meaningful proxies for incarceration rates. Each of these variables was associated with gonorrhea rates a year later (Table 2), as well as the social measures of neighborhood characteristics in the same year (data not shown). Although this is inconclusive evidence of a causal chain running from high incarceration rates to neighborhood effects to STDs, the body of literature relevant to this chain consistently points to its existence.

Incarceration is a factor that can play a role in each of the measures of social ties. Each depends in part on longevity of relationships, which is upset by moving people between their home and prison. Moreover, the prisoner's loved ones may also need to move to find less expensive housing or a new source of income. Social cohesion and social control depend on familiarity and trust between neighbors which are undermined by residential mobility. Residential mobility also contributes to social disorder. New residents, especially those released from prison, are typically not as well integrated into the community as long-time residents. Furthermore, prison is an acculturating environment that may lead to norms and values not shared by the community into which a prisoner is released.

Study Implications

The unit of analysis in this study was the neighborhood; therefore, the characteristics of individuals that contribute to STD risks cannot be factored in. Moreover, our use of a 1-year lag only approximates a longitudinal analysis. A multilevel

longitudinal study is now needed to more firmly establish the links between incarceration and neighborhood characteristics, and between those characteristics and health among individuals in the neighborhoods. Such a study should include those left behind in the community as well as prisoners and ex-offenders, and because incarceration touches virtually every aspect of life, relevant health-related outcomes should extend beyond STDs and teen pregnancy to include illicit drug use, mental health, and diabetes, for example.

Whether high incarceration rates stress the social fabric of communities is a question meriting further investigation. However, we and others have shown a relationship between neighborhood social characteristics and STDs. These findings indicate that factors beyond individual level decisions to abstain from sex, remain faithful to a sexual partner, or use condoms contribute to the occurrence of community STD rates. Otherwise stated, individual behaviors are shaped in part by the community. Programs that strengthen the social fabric of communities experiencing high rates of STDs may, thus, lower the rates.

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